Inventions & Innovation Project Abstract

A Bio-Based Fuel Cell for Distributed Energy Generation

Existing distributed energy (DE) generation technologies generally rely on fossil fuels, or are generally ill-suited for widespread adoption (e.g. wind power). While a great deal of resources has been devoted to realizing a hydrogen economy, serious obstacles remain in achieving this goal. For example, the production, transportation and storage of hydrogen, as well as the costly components of H2-based fuel cells, pose major immediate and long-term difficulties in adopting this technology. Alternative fuel cell strategies, which avoid these issues, may be more feasible. Particularly attractive are bio-based approaches which use enzymes or entire cells to directly convert renewable organic compounds into electricity. We show that the estimated power production of our bio-fuel cell (BFC) system design should be sufficient to warrant employing this approach in the production of large-scale generators for distributed energy generation. The objective of this project is to develop a proof-of-principle bench-scale model of a functional BFC.

The proposed technology would enhance energy productivity by diversifying the types of fuel used in the generation of electricity, and would provide a clean energy source (BFCs emit only carbon dioxide as a waste product) to consumers. The BFC represents a highly efficient (>80%) small-scale, modular DE technology capable of enhancing on-grid energy needs, or providing stand-alone power generation. Thus the development of a functional BFC has direct relevance to this area of the Department of Energy's DE Program.

The proposed technology also fits within the Energy Efficiency and Renewable Energy mission in that it would (1) serve to dramatically reduce dependence on foreign oil by using bio-fuels (such as acetate and even simple sugars) for the generation of electricity, (2) increase the viability of renewable energy technologies by overcoming many of the limitations of current approaches which interfere with their widespread adoption, (3) increase the reliability of electricity generation by serving as an efficient complementary energy source to consumers in areas prone to outages and/or "brownouts", and (4) create a new bioindustry centered on producing bio-fuels from renewable, domestic sources (i.e. fermentation of many types of biomass).

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